COSEWIC
Status Appraisal Summary

on the

Kidneyshell
Ptychobranchus fasciolaris

in Canada

ENDANGERED
2013

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC
Assessment Summary

Assessment Summary – May 2013

Common name
Kidneyshell

Scientific name
Ptychobranchus fasciolaris

Status
Endangered

Reason for designation
By 2001, this species had been lost from about 70% of its historical range in Canada due to the impacts of the Zebra Mussel and habitat loss from land use practices. It is now restricted to the East Sydenham and Ausable rivers, Lake St. Clair delta, and Medway Creek of the Thames River. The population in Lake St. Clair is close to extirpation. Both Ausable and East Sydenham river populations appear to be reproducing, but populations in Medway Creek and Lake St. Clair are not reproducing. Populations are threatened by pollution from agriculture, urban and road runoff sources, and invasive species (dreissenids and Round Goby).

Occurrence
Ontario

Status history
Designated Endangered in May 2003. Status re-examined and confirmed in May 2013.

COSEWIC
Status Appraisal Summary

Ptychobranchus fasciolaris
Kidneyshell — Ptychobranche réniforme
Range of occurrence in Canada: Ontario

Status History
Designated Endangered in May 2003. Status re-examined and confirmed in May 2013.

Evidence (indicate as applicable):

Wildlife species:
Change in eligibility, taxonomy or designatable units: yes ☐ no ☒

Explanation:

There has been no change to the formal taxonomy and the Canadian population of *Ptychobranchis fasciolaris* remains as one Designatable Unit. The recognized authority for the classification of aquatic molluscs in the United States and Canada is Turgeon *et al.* (1998).

Range:
Change in Extent of Occurrence (EO): yes ☒ no ☐ unk ☐
Change in Index of Area of Occupancy (IAO): yes ☒ no ☐ unk ☐
*Change in number of known or inferred current locations**: yes ☒ no ☐ unk ☐
Significant new survey information yes ☒ no ☐

Explanation:

EO - This mussel is still present in the Ausable River, East Sydenham River, and portion of the Lake St. Clair delta. Two live specimens were found in two mussel relocations in Medway Creek (tributary of Thames River) in 2006 and 2007 using sediment excavations down to 10 cm within 720, 1-m^2 quadrats and sieving through 7-mm mesh openings (Mackie 2006b,c, 2007a). The newly calculated historical (1885-2012) EO is 33,663 km^2 (Figure 1), which declined to 2050 km^2 in 2001 (COSEWIC 2003), but has subsequently increased to 2866 km^2 over the last 10 years (Figure 2), largely due to increased search effort. Six other sites (total 1664 m^2) were excavated on the Thames River between 2004 and 2011 and no Kidneyshells were found (Mackie 2004, 2010c, 2011). The species is apparently still absent in the Grand River because none were found after excavating sediments at 11 sites (total 3679 m^2) between 2007 and 2010 (Mackie 2006a, 2007b, 2008a, 2009, 2010b). A survey (70 p-h, person-hours) of the lower Ausable River at Port Franks also yielded no Kidneyshells (Mackie 2008b).

IAO - The species is still in the 100 km reach of East Sydenham River between Napier and Dawn Mills, the 25 km reach of Ausable River between Brinsley and Nairn, and in a portion of the Lake St. Clair delta. The newly calculated (2 km x 2 km grid) historical IAO is 208 km^2 (Figure 3) while the current IAO is 80 km^2 over the last 10 years (Figure 4), the increase being a result of finding a new location in Medway Creek (tributary of Thames River). The AO in 2001 was 10.4 km^2 (COSEWIC 2003).

Locations - COSEWIC (2003) reported three locations (East Sydenham River, Ausable River, Lake St. Clair delta). The East Sydenham and Lake St. Clair localities could be combined into one location (the river flows into the delta) due to the very high impact threat from agricultural and road runoff pollution. In

addition, Lake St. Clair is an epicenter of invasive species, especially Round Goby (*Neogobius melanostomus*), that is pervasive throughout the lake and most of the Sydenham River. They also could be considered separate locations. The other two locations are the Thames and Ausable rivers, and are based on the threat of pollution.

* Use the IUCN definition of "location"

Population Information:

Change in number of mature individuals:	yes ☐ no ☐ unk ☒
Change in total population trend:	yes ☒ no ☐ unk ☐
Change in severity of population fragmentation:	yes ☐ no ☒ unk ☐
Change in trend in area and/or quality of habitat:	yes ☒ no ☐ unk ☐
Significant new survey information:	yes ☒ no ☐

Explanation:

The finding of two mature, probably senescing individuals (upper end of size class) in a new site, Medway Creek, is a result of increased search effort, however the density is small (0.003/m^2) and represents only 0.03% of the unionid community (Mackie 2006b,c). While the two specimens were at the top of their size class, it is unknown what proportions of individuals were mature in other populations.

Morris and Di Maio (1998) surveyed six sites on the Ausable River in 1993-94 using 1 p-h sampling effort and found a total of six live Kidneyshells at two sites, representing 2% (6/266) of the overall community. Metcalfe-Smith *et al.* (1999) surveyed eight sites on the river in 1998 and found 27 live specimens at two of the sites where the species was found alive in 1993-94, as well as 16 fresh and eight weathered shells at these and two other sites in this reach; overall, the Kidneyshell represented just 1.5% (27/1849) of the mussel community in the river, 1.5% at Nairn and 4.5% at Brinsley. Several surveys using catch per unit effort (CPUE) were done in 2002 when 32 specimens (range 1-29 specimens) were found at four sites after 18.5 p-h, or 0.43 *P. fasciolaris*/p-h/site; in 2004 after 13.5 p-h only 0.1 *P. fasciolaris*/p-h/site was found. Baitz *et al.* (2008) found even larger populations in 2006 at four of seven sites with an average density of ~0.47/m^2 and constituted approximately 4% of the overall mussel community; the largest populations were at Ailsa Craig (93 specimens, 18.1/m^2) and Nairn (36 specimens, 12.6/m^2), with three (4.0/m^2) and six (3.6/m^2) at two other sites. In 2008 no *P. fasciolaris* was found in 620 m^2 at Port Franks, ON (Mackie 2008b). In 2010 only one *P. fasciolaris* was found after searching for 15 p-h at the Nairn site where 29 specimens were found in 2002, a decline from 6.4/p-h in 2002 to 0.07 in 2010, or 55% over eight years. Ausable Bayfield Conservation Authority collected 82 live Kidneyshells in 2011, representing 3.5% (82/2325) of all mussels collected (DFO 2013).

Metcalfe-Smith *et al.* (1998a,b, 1999) surveyed 17 sites on the Sydenham River in 1997-98, and found live specimens at nine sites, or 75% of the sites in the east branch; abundance was very low with only 26 of the 2242 live mussels collected (1.1%) being *P. fasciolaris*. In a 2001 survey where it was previously found alive, it occurred at an average estimated density of 0.12/m^2 and comprised only 0.3% of the overall mussel community (COSEWIC 2003). Many surveys have been carried out since 2002 but search effort is unknown for some years (DFO unpubl. data). For example, in 2002, 84 live shells were found at 24 sites (mean 3.5/site), search effort unknown; one site at Croton was quantitatively sampled and 10 live *P. fasciolaris* were found in 75 m^2, or 0.13/m^2. In 2003, 1-28 live specimens were found at seven sites (mean 9/site) with a mean density of 0.05/m^2 at three of the sites. In 2005, 1-26 live *P. fasciolaris* were found at four sites (mean =9.3/site) for 107 p-h (mean = 0.09/p-h). In 2006, 6-15 live *P. fasciolaris* (mean =10.5/site) were found after 37 p-h at two sites (mean = 0.57/p-h). In 2008, 3-9 live *P. fasciolaris* were collected at two sites (mean 6.0/site) after 13.5 p-h (mean = 0.89/p-h); Zanatta (pers. comm. 2012) collected 133 specimens at three of the richest sites (Croton, Florence, Dawn Mills) in 2008 (targeted searches, search effort unknown). In 2009, 4-24 live Kidneyshell were found at six sites (mean = 8.2/site) after 40 p-h (mean = 6.7/p-h). In 2010, 0-21 live *P. fasciolaris* were found at three sites (mean 6.3/site) after 37.5 p-h (mean = 3.2/p-h). Using the quantitative (e.g., quadrats) and semi-quantitative data (e.g., CPUE) to determine trends, densities appear to have declined from 0.13/m^2 in 2002 to 0.05 in 2003, or 38%; CPUE data for 2005 (0.09/p-h; 2006 (0.57/p-h); 2008 (0.89/p-h), 2009 (6.7/p-h), and 2010 (3.2/p-h) show no obvious trend. Because only animals at the surface are detected using CPUE, trends may be

suspect when using both CPUE and quadrat excavations. In summary, populations appear to be stable at most sites in the Sydenham River, especially at Croton, Florence, and Dawn Mills. The lower Sydenham may be devoid of Kidneyshell, based on 42 p-h of searching at Wallaceburg in 2008 (Mackie 2008c). Zanatta *et al.* (2002) surveyed 95 sites in nearshore areas around Lake St. Clair between 1998 and 2001 and found live mussels at 33 sites, most of which were in the St. Clair delta. Only seven (0.3%) of the 2356 live mussels collected were Kidneyshells. Metcalfe-Smith *et al.* (2004) reported the density of Kidneyshell in Lake St. Clair in 2003 at 0.00007/m^2. Only one Kidneyshell was found at nine sites in the delta in 2003. DFO resurveyed those nine sites in 2011 and found none. If still present in the delta they are very rare. Comparisons of collections made in 2001 with those in 2003 showed that abundance of all unionids in Lake St. Clair had declined by about 14% (Metcalfe-Smith *et al.* 2004), even though these sites were associated with low Zebra Mussel (*Dreissena polymorpha*) infestation rates and high unionid diversity. The delta is a potential refuge site because Zebra Mussel infestations of unionids appears to be mitigated by dominant offshore currents, which limit densities of Zebra Mussel veligers in nearshore compared to offshore waters (13,600 vs. 28,000/m^3, respectively) (McGoldrick *et al.* 2009).

Ptychobranchis fasciolaris was last found alive in Lake Erie off Pelee Island in 1992 (DFO unpubl. data) and was not found in four surveys in 2005 nor in two surveys in Rondeau Bay in 2010. Unionids have been largely eliminated from Lake Erie since the invasion of the Zebra Mussel (Mackie and Claudi 2010). The Kidneyshell has not been found in the Grand River since 1888 (COSEWIC 2003) and was not found in numerous extensive surveys using excavation between 2007 and 2010 (Mackie 2010d). The species appears to be extirpated from both the upper and lower Grand River.

The Kidneyshell has not been recorded from the Thames River since 1894 at Chatham when one fresh whole shell was found (DFO unpubl. data). Several surveys on the Upper and Lower Thames River itself (Medway Creek sites where Kidneyshells recently found not included) by Morris (1996), Mackie (2004, 2006b,c, 2007a, 2010a) and Morris and Edwards (2007) between London and Mitchell yielded no Kidneyshells.

In summary, Kidneyshell populations continue to decline in Lake St. Clair and Ausable River, while populations in the Sydenham River appear stable. The species is now extirpated in upper and lower Thames and Grand rivers and in Lake Erie off Pelee Island. The new population in Medway Creek is well isolated from the main branch of the Thames River and consists of two individuals at the top of their age class; both appear to be senescing and runoff from roadways at a new housing development immediately upstream threatens the small population. Extent, area and quality of habitat are declining in Lake St. Clair and Ausable River (see **Threats** section).

Threats:

Change in nature and/or severity of threats: yes ☒ no ☐ unk ☐

Explanation:

The threats calculator (Appendix I) was done by the report writer and results were reviewed by the Molluscs SSC, which includes the Chair of the Recovery Team. Fisheries and Oceans Canada (DFO 2013) also did a threats analysis based on their expected relative impacts, spatial extent, frequency, expected severity and causal certainty; the IUCN/COSEWIC threats calculator results agree with the DFO assessment. Most of the threats reported in COSEWIC (2003) continue to degrade habitat extent and quality, some at an apparently accelerated rate. Based on IUCN/COSEWIC threats calculator (numbers refer to those in Appendix 1), the threats can be summarized from very high to low impact threats into ten categories. One is a very high impact threat: pollution (9, urban waste water, industrial and agricultural pollution). Two are high impact threats: invasive species (8, dreissenids and Round Goby) and climate change (11, water quantity). One is ranked as a high to low impact threat: biological resource use (5, declines in host fishes). One is ranked as a medium impact threat: natural system modifications (7, many dams and impoundments on the Thames and Ausable rivers). Five are ranked as low impact threats: residential and commercial development (1, new housing development); agriculture with livestock farming (2, cattle in streams); energy production and mining (3, oil drilling); transportation & service corridors (4, shipping lanes); human intrusions & disturbance (6, physical habitat loss/modification by ATV activities).

Pollution: runoff from streets carries polyaromatic hydrocarbons and other organic contaminants; sediments; thermal pollution received by Lake St. Clair from the Sydenham River. Agriculture accounts for 75-85% of land use in the Thames River basin; tile drainage, wastewater drains, manure storage and spreading, and insufficient soil conservation have all contributed to poor water quality within the Sydenham and Thames basins (DFO 2013). The watershed of Lake St. Clair is 75-85% agriculture and contributes suspended material into the Sydenham rivers that empty into Lake St. Clair.

Juvenile mussels are among the most sensitive aquatic organisms to ammonia toxicity (Mummert *et al.* 2003; Newton 2003; Newton *et al.* 2003; Newton and Bartsch 2007). The Sydenham River has historically shown high nutrient and phosphorous levels that have regularly exceeded provincial water quality levels over the last 30 years (Staton *et al.* 2003). The potential risk that copper poses to mussel populations was assessed by Gillis *et al.* (2008, 2010) by comparing copper and dissolved organic carbon concentrations from significant mussel habitats in Ontario to the 50% effective concentration for *Lampsilis fasciola*, another mussel species. Although overall mean copper concentration in the mussel's habitat was well below the acutely toxic level given the concentration of dissolved organic carbon, episodic copper releases in low dissolved organic carbon waters may be a concern for the recovery of endangered freshwater mussels (Gillis *et al.* 2010).

Southern Ontario is riddled with road ways and levels of toxic chemicals, like chloride, have increased due to an increased use of road salt (Staton *et al.* 2003). Chloride levels in the Sydenham River have been reported at levels greater than 1300 mgL^{-1}, which were shown to be toxic to glochidia of the Wavyrayed Lampmussel, *Lampsilis fasciola*, given the right calcium hardness conditions (Gillis 2011); considering the density of road ways in Southern Ontario, chloride is likely a huge threat to the early life stages of freshwater mussels.

The overuse of herbicides and pesticides, release of urban and industrial pollution into rivers, nutrient loadings from fertilizers, municipal wastewater and domestic septic systems, and roadway runoff that contains salts, heavy metals, polyaromatic hydrocarbons, etc. are all a result of urbanization and can alter water chemistry affecting habitat and host fish availability for the Kidneyshell (DFO 2013). Gagné *et al.* (2004, 2011) and Gagnon *et al.* (2006) showed that exposure to municipal effluent containing pharmaceuticals can negatively affect unionid health by disrupting gonad physiology and reproduction of this species.

Invasive species: The Zebra Mussel is of particular concern in lakes as well as rivers as long as there is an upstream impoundment that has a retention time greater than 21 days (Mackie and Claudi 2010). These invasive mussels are known to cause death to unionids (Mackie and Claudi 2010). The Kidneyshell has been declining in Lake St. Clair since the Zebra Mussel arrived in 1986 (Gillis and Mackie 1994) and is now near extirpation (see **Population Information**) with only one Kidneyshell detected in nearly 15,000 m^2 searched in 2003 (Metcalfe-Smith *et al.* 2004) with a relative abundance of 0.11% and a percent occurrence of 6.3 at 32 sites in 2003 and 2005 (McGoldrick *et al.* 2009). Although there are few Kidneyshells, the delta (~100 km^2) so far is providing an important refuge for other native unionids. The Ausable River has no navigable impoundments (Ausable River Recovery Team 2006) which limits the threat of Zebra Mussels in this watershed.

The Round Goby is a new threat and this fish is threatening many host fish of unionids in the entire lower Great Lakes and its tributaries by competing with other benthic fish and feeding on their eggs and juveniles (Poos *et al.* 2010). Declines in populations of native benthic fish species that are hosts for many mussel species at risk include Logperch (*Percina caprodes*), Mottled Sculpin (*Cottus bairdii*), Johnny Darter (*Etheostoma nigrum*), Trout-perch (*Percopsis omiscomaycus*), Fantail Darter (*E. flabellare*), and Greenside Darter (*E. blennioides*) in the St. Clair River (French and Jude 2001) and Lake St. Clair (Thomas and Haas 2004). Poos *et al.* (2010) estimated that 89% of benthic fishes and 17% of mussels that occur in rivers where the secondary invasion of the Round Goby has occurred have been or will be negatively impacted; in particular, Poos *et al.* (2010) reported Round Goby in the Lake St. Clair delta and lower portions of several rivers including the Sydenham River between 2003 and 2008, suggesting that upstream invasion was in progress. Tremblay (2012) successfully infested Round Goby with three mussel

species which metamorphosed on two at risk mussels (*E. triquetra, V. iris)* but at low rates. Approximately 39.4% and 6.3% of *N. melanostomus* collected from areas of unionid occurrence in the Grand and Sydenham rivers (southwestern ON), had body burdens of glochidia, respectively. The results indicate that *N. melanostomus* serves more as a sink for glochidia than as a host for unionids, and suggests a novel way in which *N. melanostomus* is affecting native species. The continued spread of the Round Goby thus poses a real threat to host fish populations and could devastate remaining mussel populations by disrupting their reproductive cycle (DFO 2013).

Climate change: Climate changes can alter the quantity of water which can dislodge mussels from areas of suitable habitat into areas of marginal habitat during high flows and depress dissolved oxygen levels, elevate stream temperatures, and cause desiccation during low flows. Spooner *et al.* (2011) examined how anticipated shifts in water flow would affect affiliate species–discharge relationships (SDR) and impact co-extirpations of mussels and fish. They found that the strength and predictability of SDR models varied geographically with the patterns of extirpations strongest in the southeastern US where: (a) flow reductions are expected to be greatest; (b) more species are lost per unit flow; (c) and more mussels are expected to be lost per unit of fish. Also, overall mussel losses associated with reduction in water availability were greater than losses of host fishes.

Biological resource use: Declines in host fishes may be related to human-mediated "predation" such as the bait fishery. Blackside Darter (*Percina maculata*), Fantail Darter (*Etheostoma flabellare*), Johnny Darter (*E. nigrum*), Iowa Darter (*E. exile*), and Brook Stickleback (*Culaea inconstans*) are hosts for Kidneyshell (McNichols 2007). While some of the species are abundant, Fantail Darters are neither abundant nor widespread in the Ausable and Sydenham rivers. The Iowa Darter and Brook Stickleback have not been reported in the Upper Thames. If Iowa and Fantail darters and Brook Stickleback are the primary (preferred) hosts, the Kidneyshell would be in danger of being host-limited in these rivers.

Natural system modifications: In addition to dredging (included in the transportation and service corridor threat, below), grading, excavation, in-water structures, dams/barriers, and water level management all are natural system modifications. Any form of channelization can result in flow reduction and practices and/or changes in water temperatures and negatively affect the Kidneyshell. Artificial impoundments effectively fragment habitat converting a riverine community into a lacustrine one, which can eliminate the mussels themselves or the host fishes. Altered water levels, habitat conversion and the clearing of riparian zones resulting in the loss of cover, increased rates of siltation and thermal shifts can all be deleterious to downstream Kidneyshell populations (DFO 2013). There are three large reservoirs and 173 private dams and weirs on the Thames and 21 dams on the Ausable rivers (COSEWIC 2003).

Residential and commercial development: There is one new housing development expected near London.

Agriculture with livestock farming: The Sydenham and Thames rivers are two large tributaries of Lake St. Clair and agriculture is pervasive in both rivers with over 85% of the land in the Sydenham River watershed in agricultural use, of which 60% is tile drainage (Dextrase *et al.* 2003). Cattle frequently enter the streams, likely trampling many mussels.

Energy production: In 2006 there were 1,045 active oil wells with about 100 new oil and gas wells drilled in southern Ontario each year (OMNR 2011). Wells no longer used for the purpose for which they were drilled or wells that did not produce oil or gas must be plugged according to provincial standards under the *Oil, Gas and Salt Resources Act* and the surface must be rehabilitated; on average 100 depleted wells are plugged every year (OMNR 2011). Plugging is to be done as soon as possible after the well is taken out of service. Water with chloride and some PAHs escaping from the well will kill vegetation, create unusual wetness, and possibly leak sulphur water creating hydrogen sulphide odor (Petroleum Resource Centre 1999). Clearly there is potential, albeit low, for oil contamination of surface and/or ground waters.

Transportation & service corridors: Dredging can result in the direct destruction of mussel habitat and lead to siltation and sand accumulation of local and downstream mussel beds. Dredging is done frequently in the Lake St. Clair shipping channel; 30,500 cubic yards of shoals were expected to be

dredged from the navigation channel of Lake St Clair in 2010 (Dredging News Online 2010).

Human intrusions & disturbance: In-stream recreational activities, like ATVs running up and down streams, can kill mussels and disturb their habitat.

Protection:
Change in effective protection: yes ☐ no ☒

Explanation:

The species was assessed as endangered by COSEWIC in 2003 and was placed on Schedule 1 of SARA and on SARO (Species at Risk in Ontario). The species does not receive habitat protection under SARA at this point in time, only species protection. The Federal *Fisheries Act* historically represented the single most important piece of legislation protecting the Kidneyshell and its habitat in Canada. However, recent changes to the *Fisheries Act* have significantly altered protection for this species and it is unclear at this time if the *Fisheries Act* will continue to provide protection for this species. The species was listed under Schedule 3 of Ontario's *Endangered Species Act*, 2007 (ESA) and receives species protection under this Act, but will not receive habitat protection until June of 2013.

The Ontario Ministry of Natural Resources implemented the *Endangered Species Act* in 2007. Compared to Ontario's previous Act, the new ESA 2007 provides broader protection for species at risk and their habitats. Endangered, threatened, and extirpated species on the COSSARO list automatically receive legal protection under the ESA 2007. Habitat is not currently protected for Kidneyshell under Ontario's ESA, but will have General Habitat Protection as of June 30, 2013.

Rescue Effect:
Change in evidence of rescue effect: yes ☐ no ☒

Explanation:

The Kidneyshell occurs in 12 states of the USA, ranging from Mississippi and Alabama in the south to Michigan in the north, and from eastern Illinois to Virginia. Except for Illinois, most populations are abundant and apparently stable; the species has been lost from three of five rivers in Illinois. The species is sporadically distributed in Ohio and abundant in Michigan but it is not possible for immigration to occur from most of the nearby locations (IUCN definition) by natural means. Rescue could occur from tributaries of Lake St. Clair in Michigan because *P. fasciolaris* occurs in Clinton River (Morowski *et al.* 2009) and Belle River in the St. Clair River drainage (Woolnough pers. comm. 2012; Zanatta pers. comm. 2012). Evidence of gene flow has been documented (Rowe 2012) between the Belle River and the St. Clair delta for another unionid (*Lampsilis siliquoidea*, Fatmucket) thus rescue is conceivable. However, survival is not likely because the Zebra Mussel infestation throughout Lake St. Clair has eliminated most of the suitable habitat, particularly on the southern and western shores in the lake (Gillis and Mackie 1994). Transplanting of juveniles raised artificially in the lab is being proposed to help re-establish populations in historically occupied habitats but genetic testing is still required (DFO 2013).

Quantitative Analysis:
Change in estimated probability of extirpation: yes ☐ no ☒ unk ☐

Details:

As in the COSEWIC (2003) status report, there are still no data to estimate the probability of extinction.

Summary and Additional Considerations: [e.g., recovery efforts]

Except for declines in Illinois, the distribution and abundance of P. fasciolaris in the U.S. is considered stable. In Canada, it was historically found in Lake Erie, Lake St. Clair, and the Niagara, Detroit, Grand,

Thames, Sydenham and Ausable rivers. It was always sparse in Great Lakes waters, and has now been extirpated due to impacts of the Zebra Mussel. It has disappeared from the Grand River, where it historically occupied the lower 50 km of the main stem. It has likely been lost from the main branch of the Thames River but increased search effort found it in Medway Creek, a tributary of the Thames River. It is restricted to a 100-km reach of the East Sydenham River and at Oil Springs on the North Branch, and a 25-km reach of the Ausable River. Both the Sydenham and Ausable river populations appear to be reproducing. The populations in Lake St. Clair are still declining and are extirpated in Lake Erie and the Grand and Thames rivers. There are no historical data available for the Ausable River, but several other nationally endangered riffle-dwelling species have been extirpated, or nearly so, from this river. Overall, P. fasciolaris has been lost from about 70% of its historical range in Canada. Spread of Round Goby and invasion of the Zebra Mussel in impoundments has further reduced the extent, area and quality of habitat.

Ecosystem recovery strategies have been developed for mussel species at risk in the Sydenham River (Sydenham River Recovery Team 2002; Dextrase et al. 2003), the Thames River (Thames River Recovery Team 2003) and the Ausable River (Ausable River Recovery Team 2004). A recovery strategy for the Kidneyshell was completed in 2006 (Morris 2006) but did not include descriptions of critical habitat. A new Recovery Strategy for the Kidneyshell is being proposed by the Ontario Freshwater Mussel Recovery Team (DFO 2013) and defines critical habitat in the Sydenham, Ausable and Thames rivers (including Medway Creek). Additional areas of potential critical habitat for these species in Lake St. Clair will be considered in collaboration with Walpole Island First Nation. A schedule of studies has been developed that outlines the necessary steps to obtain the information to further refine these critical habitat descriptions. Until critical habitat has been fully identified, the recovery team recommends that currently occupied habitats are habitats in need of conservation.

Acknowledgements and authorities contacted:

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*Denotes that information was provided by authority contacted.

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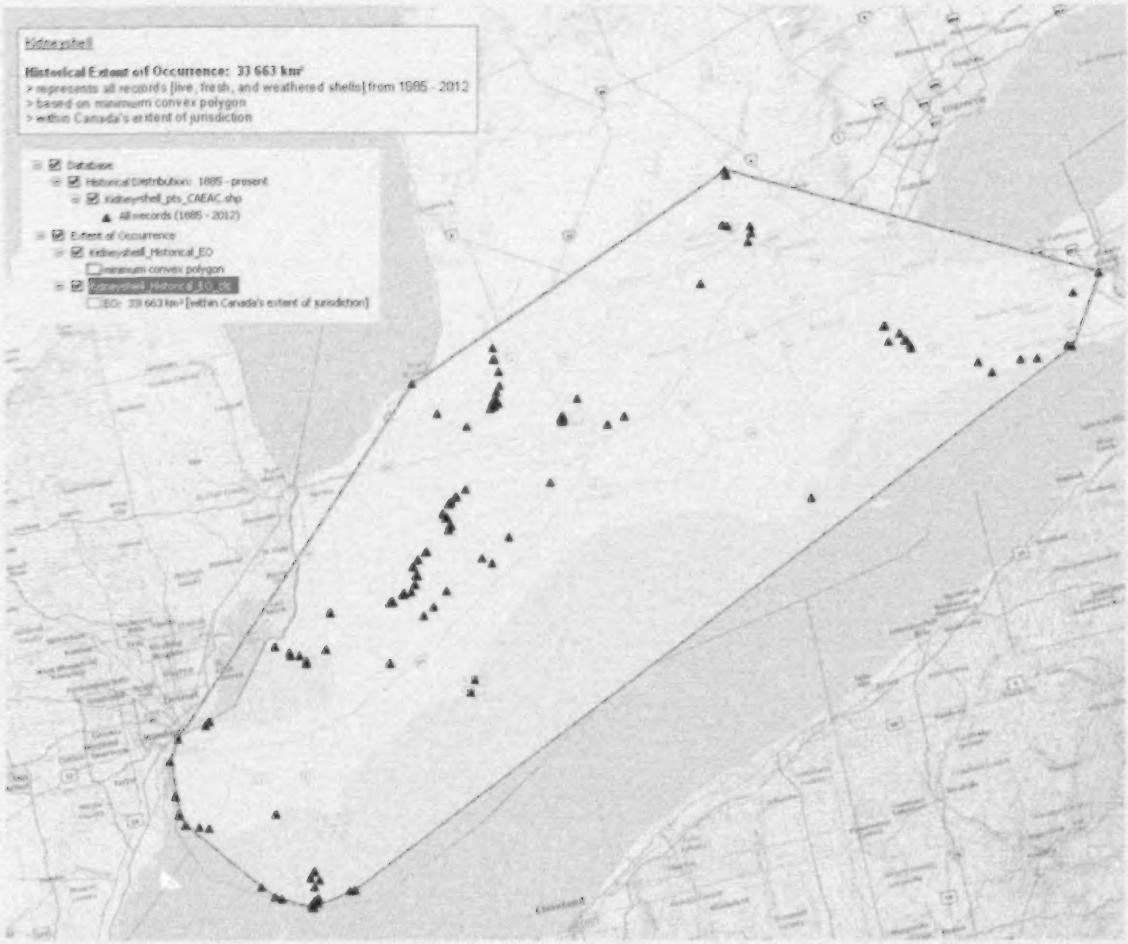
Kidneyshell
Historical Extent of Occurrence: 33 663 km²
> represents all records (live, fresh, and weathered shells) from 1885 - 2012
> based on minimum convex polygon
> within Canada's extent of jurisdiction
Database
Historical Distribution: 1885 - present
kidneyshell_pts_CAEAC.shp
All records (1885 - 2012)
Extent of Occurrence
kidneyshell_Historical_EO
minimum convex polygon
kidneyshell_Historical_EO_clip
EO= 33 663 km² [within Canada's extent of jurisdiction]

Figure 1. Historical Extent of Occurrence for *Ptychobrancus fasciolaris*, which shows all records (live, fresh, and weathered shells) from 1885 to 2012 and is based on minimum convex polygon within Canada's extent of jurisdiction.

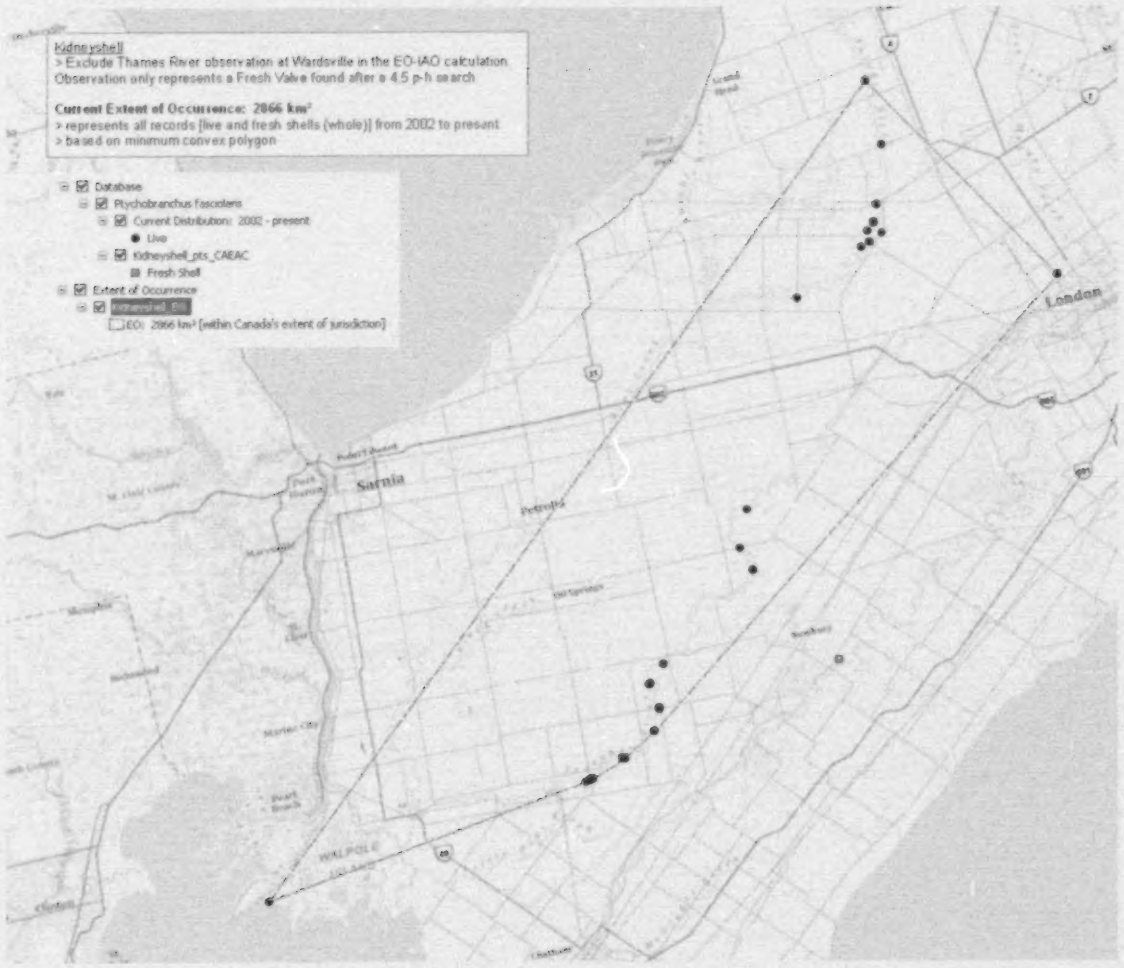
Kidneyshell
> Exclude Thames River observation at Wardsville in the EO-IAO calculation
Observation only represents a Fresh Valve found after a 4.5 p-h search
Current Extent of Occurrence: 2066 km²
> represents all records [live and fresh shells (whole)] from 2002 to present
> based on minimum convex polygon
Database
Ptychobranchus fasciolaris
Current Distribution: 2002 - present
Live
Kidneyshell_pts_CAEAC
Fresh Shell
Extent of Occurrence
Kidneyshell_EO
EO: 2066 km² [within Canada's extent of jurisdiction]
Sarnia
London

Figure 2. Current Extent of Occurrence for *Ptychobranchus fasciolaris*, which shows sites of live and fresh shells (whole) from 2002 to present based on minimum convex polygon. The single valve (fresh shell) found after 4.5 p-h search was excluded from the calculation as it does not likely represent a living population.

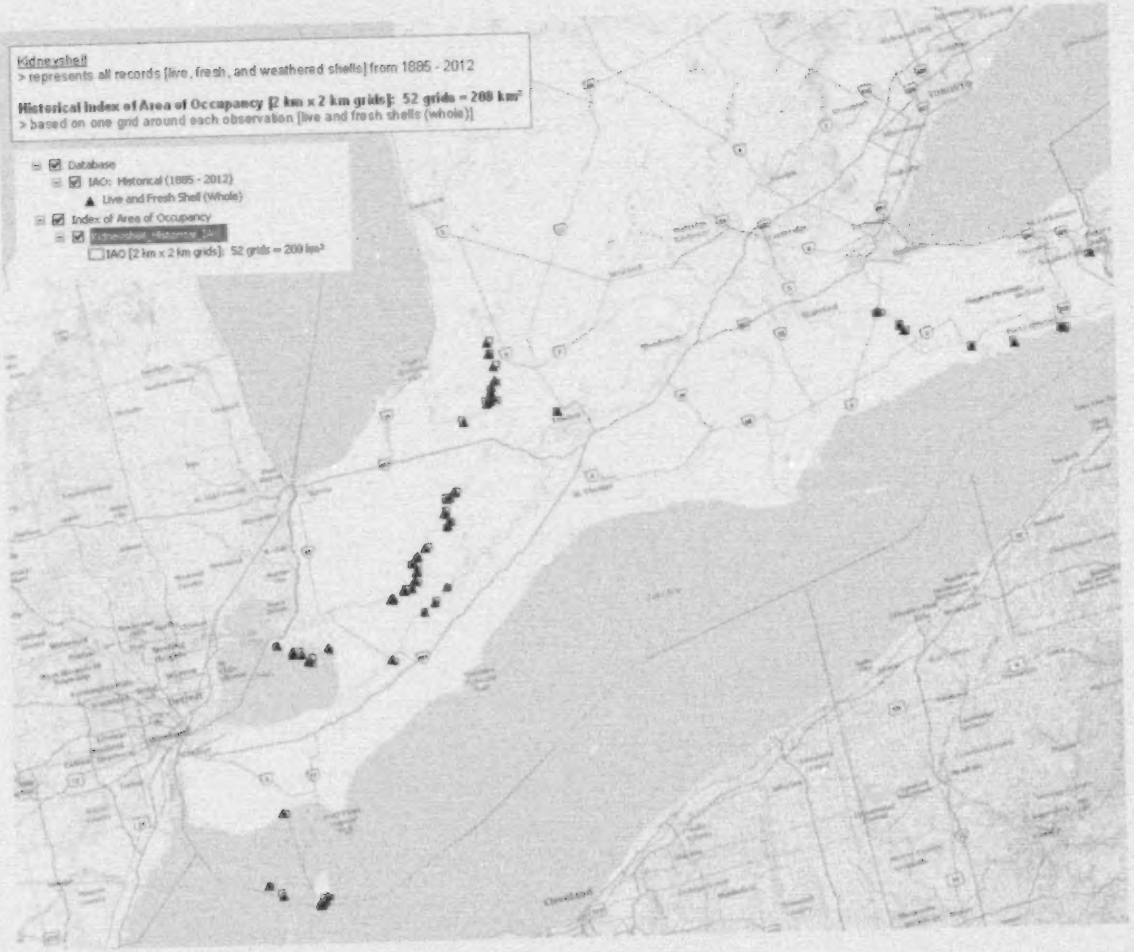
Kidneyshell
> represents all records [live, fresh, and weathered shells] from 1885 - 2012
Historical Index of Area of Occupancy [2 km x 2 km grids]: 52 grids = 208 km²
> based on one grid around each observation [live and fresh shells (whole)]
Database
IAO: Historical (1885 - 2012)
Live and Fresh Shell (Whole)
Index of Area of Occupancy
IAO [2 km x 2 km grids]: 52 grids = 208 km²

Figure 3. Historical Index of Area of Occupancy for *Ptychobranhus fasciolaris* with 52, 2 km x 2 km grids based on one grid around each observation [live and fresh shells (whole)].

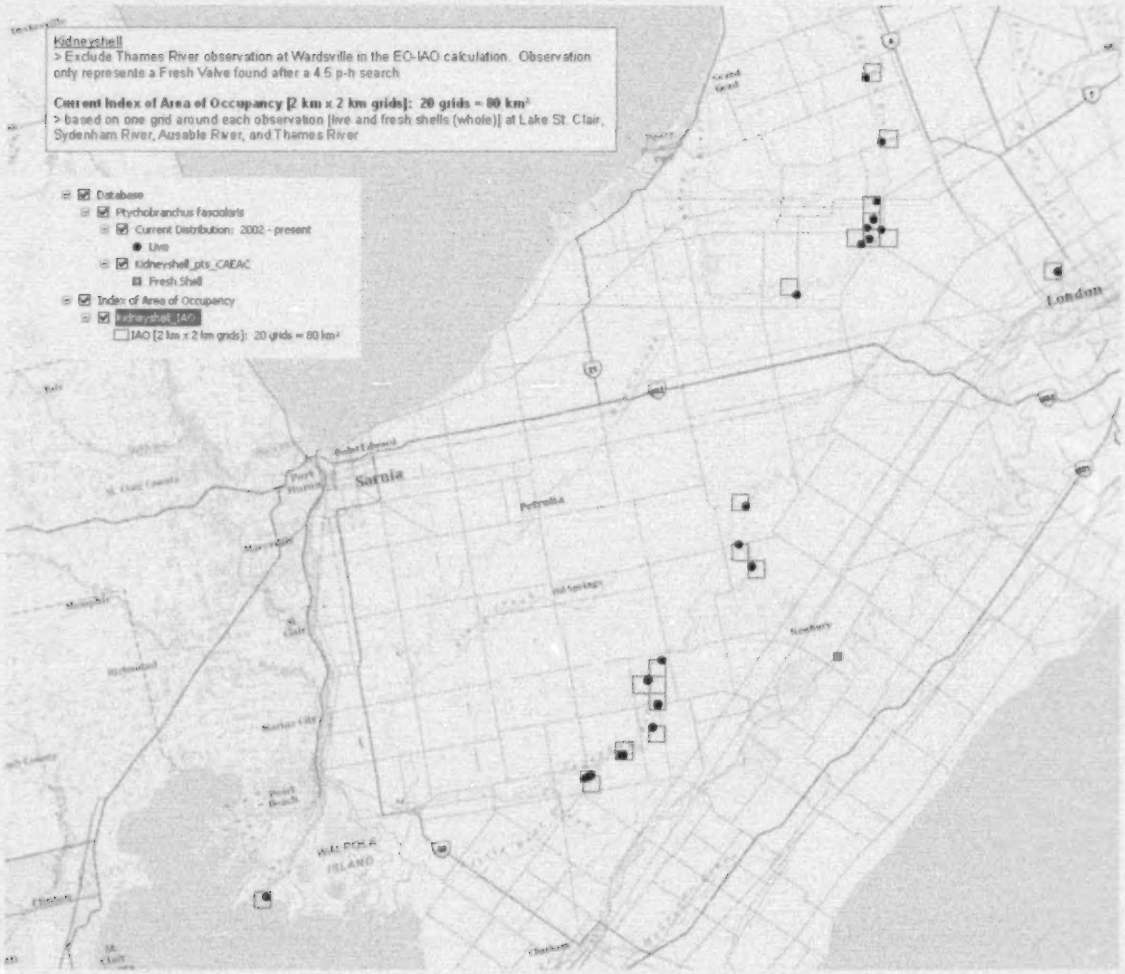
Kidneyshell
> Exclude Thames River observation at Wardsville in the EO-IAO calculation. Observation only represents a Fresh Valve found after a 4.5 p-h search
Current Index of Area of Occupancy [2 km x 2 km grids]: 20 grids = 80 km²
> based on one grid around each observation [live and fresh shells (whole)] at Lake St. Clair, Sydenham River, Ausable River, and Thames River
Database
Ptychobranchus fasciolaris
Current Distribution: 2002 - present
Live
Kidneyshell_pts_CAEAC
Fresh Shell
Index of Area of Occupancy
Kidneyshell_IAO
IAO [2 km x 2 km grids]: 20 grids = 80 km²
Sarnia
London
Petrolia

Figure 4. Current Index of Area of Occupancy (2 km x 2 km grids) for *Ptychobranchus fasciolaris* with 20 grids, based on one grid around each observation [live and fresh shells (whole)] at Lake St. Clair, Sydenham River, Ausable River, and Thames River. The single valve (fresh shell) found after 4.5 p-h search was excluded from the calculation as it does not likely represent a living population.

Appendix I. Threats Calculator for Kidneyshell, *Ptychobranchus fasciolaris*

Threat No.	Threat Description	Threat Impact		Scope	Severity	Timing	Comments
1	Residential & commercial development	D	Low	Small (1-10%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
1.1	Housing & urban areas	D	Low	Small (1-10%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	Relates to a new housing development north of Sunningdale Rd, London, ON
2	Agriculture & aquaculture	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	
2.3	Livestock farming & ranching	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	For Thames & Sydenham that empty into Lake St. Clair & Ausable that empties into Lake Huron. Cattle crossing streams trampling some mussels
3	Energy production & mining	D	Low	Small 1-10%)	Moderate (11-30%)	Moderate - Low	
3.1	Oil & gas drilling	D	Low	Small (1-10%)	Moderate (11-30%)	Moderate - Low	Applies only to southwestern ON, especially N. Sydenham River
4	Transportation & service corridors	D	Low	Small (1-10%)	Serious (31-70%)	Moderate (Possibly in the short term, < 10 yrs/3 gen))	
4.1	Shipping lanes	D	Low	Small (1-10%)	Serious (31-70%)	Moderate (Possibly in the short term, < 10 yrs/3 gen))	Lake St. Clair is a shipping lane to Detroit and St. Clair rivers; shipping lane is dredged periodically
5	Biological resource use	B D	High - Low	Large - Restricted (11-70%)	Serious - Moderate (11-70%)	High (Continuing)	
5.4	Fishing & harvesting aquatic resources	B D	High - Low	Large - Restricted (11-70%)	Serious - Moderate (11-70%)	High (Continuing)	Relates to possible/probable capture of fish and bait fish that are hosts to Kidneyshell
6	Human intrusions & disturbance	D	Low	Restricted (11-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
6.1	Recreational activities	D	Low	Restricted (11-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	Use of ATVs in shallow riffle areas of Sydenham River & possibly Ausable and Medway Creek
7	Natural system modifications	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	
7.2	Dams & water management/use	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Fanshawe Lake is an artificial impoundment on the Thames River; there are 21 dams on the Ausable River; Round Goby will affect all 3 locations
8	Invasive & other problematic species & genes	B	High	Large (31-70%)	Serious (31-70%)	High (Continuing)	
8.1	Invasive non-native/alien species	B	High	Large (31-70%)	Serious (31-70%)	High (Continuing)	Lake St. Clair is most at risk; lower Sydenham (below Wallaceburg) also at risk; Fanshawe Lake, an artificial impoundment on the Thames River is also infested with Zebra Mussels. Round Goby spreading rapidly in all locations but impact to Kidneyshell still unknown.
9	Pollution	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	

Threat No.	Threat Description	Threat Impact		Scope	Severity	Timing	Comments
9.1	Household sewage & urban waste water	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	Runoff from streets carries PAHs & other organic contaminants; sediments; thermal pollution. Lake St. Calir recieves the effluent from Thames (Medway Ck), Sydenham River; the Ausable River has wastewater treatment plants and surface runoff from roads have outfalls that empty into Lake Huron.
9.3	Agricultural & forestry effluents	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	Most farms are tiled (> 60%) and carry nutrients, sediments, bacteria, etc. to tile outfalls; watershed of three locations is 75-85% agriculture and contributes suspended material from the Thames (Medway Ck) and Sydenham rivers empty into Lake St. Clair Lake; the Ausable River empties into Lake Huron at Port Franks.
11	Climate change & severe weather	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	
11.1	Habitat shifting & alteration	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	High flows erode habitats, carry mussels downstream; low flows cause expose habitat to atmosphere and mussels to desiccation; increases in air temperature increase water temperature perhaps to lethal levels of some species; higher temperatures also decrease solubility of oxygen
11.2	Droughts	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	See 11.1
11.3	Temperature extremes	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	See 11.1
11.4	Storms & flooding	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	See 11.1

TECHNICAL SUMMARY

Ptychobranchus fasciolaris
Kidneyshell Ptychobranche réniforme
Range of occurrence in Canada (province/territory/ocean): Ontario

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used). Age structure of Kidneyshells is unknown but probably exceeds 10 yrs	Probably >10 yrs
Is there an inferred continuing decline in number of mature individuals? Inferred from decline in IAO	Probably
Estimated percent of continuing decline in total number of mature individuals within 2 generations	Unknown
Inferred percent reduction or increase in total number of mature individuals over the last 3 generations.	Unknown
Projected percent reduction or in total number of mature individuals over the next 3 generations.	Unknown
Observed percent reduction in total number of mature individuals over 3 generation period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased? Invasive species difficult to control and their spread is continuing.	Probably not reversible and ceased but understood
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence	2866 km²
Index of area of occupancy (IAO) (Based on 2 km x2 km grid).	80 km²
Is the total population severely fragmented?	No
Number of locations* 1. Ausable River, 2. East Sydenham River, portion Lake St. Clair 3. Medway Creek (Thames River). There could be 4 locations if East Sydenham River and Lake St. Clair are separate locations.	3-4
Is there an observed continuing decline in extent of occurrence?	No
Is there an observed continuing decline in index of area of occupancy?	No
Is there an inferred continuing decline in number of populations? Lake St. Clair population close to extirpation.	Yes
Is there an observed continuing decline in number of locations*? No, if Sydenham River and Lake St. Clair populations are the same location.	No
Is there an observed continuing decline in extent and quality of habitat?	Yes (for both extent and quality)
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

* See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Ausable River	thousands
East Sydenham River	thousands
Medway Creek (Thames River)	At least 2
Lake St. Clair	Close to 0
Total	thousands

Quantitative Analysis

Probability of extinction in the wild Not calculable	Unknown

Threats (actual or imminent, to populations or habitats)

The one very high impact threat is pollution from urban waste water, industrial and agricultural sources. Two high impact threats are invasive species (dreissenids and Round Goby) and climate change. A high to low impact threat is biological resource use (declines in host fishes) while the one medium impact threat is natural system modifications from the many dams and impoundments on the Thames and Ausable rivers. Five applicable low impact threats are residential and commercial development (new housing development); agriculture with livestock farming (cattle in streams); energy production and mining (oil drilling); dredging of shipping lanes (transportation and service corridors); and human intrusions and disturbance (physical habitat loss/modification by ATV activities).

Rescue Effect (immigration from outside Canada)

Status of outside population(s): Alabama (S1), Georgia (SH), Illinois (S1), Indiana (S2), Kentucky (S4S5), Michigan (SNR), Mississippi (S1), New York (S2), North Carolina (SX), Ohio (S3), Pennsylvania (S4), Tennessee (S4S5), Virginia (S4), West Virginia (S3) United States: N4N5	
Is immigration known or possible? Michigan a potential rescue to lake St. Clair population	Yes, possible
Would immigrants be adapted to survive in Canada? Lake St. Clair is infested with Zebra Mussels and Round Goby and unionids cannot compete with these invasive species	Probably not
Is there sufficient habitat for immigrants in Canada? Habitat available in Lake St. Clair delta only; all nearshore habitats infested with Zebra Mussels and not likely to reach the delta.	Yes, but restricted
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	Yes

Status History

Designated Endangered in May 2003. Status re-examined and confirmed in May 2013.

Status and Reasons for Designation

Status:	Alpha-numeric Code:
Endangered	B1ab(iii,iv)+2ab(iii,iv)

By 2001, this species had been lost from about 70% of its historical range in Canada due to impacts of the Zebra Mussel and habitat loss from land use practices. It is now restricted to the East Sydenham and Ausable rivers, Lake St Clair delta, and Medway Creek of the Thames River. The population in Lake St. Clair is close to extirpation. Both Ausable and East Sydenham river populations appear to be reproducing, but populations in Medway Creek and Lake St. Clair are not reproducing. Populations are threatened by pollution from agriculture, urban and road runoff sources and invasive species (dreissenids and Round Goby).

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. The number of mature individuals is unknown but likely fewer than 10,000.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1ab(iii,iv)+2ab(iii,iv) because EO (B1) and IAO (B2) are both below thresholds for EN. There are fewer than 5 locations (a) and there are continuing declines in habitat quality and extent (iii) and number of populations (iv).
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. While the number of individuals is likely fewer than 10,000, rates of decline are uncertain.
Criterion D (Very Small or Restricted Total Population): Meets Threatened D2 because there are fewer than 5 locations and the species is prone to the effects of human activities that can rapidly alter required habitat within a very short time.
Criterion E (Quantitative Analysis): Not applicable. No information.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2013)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.